

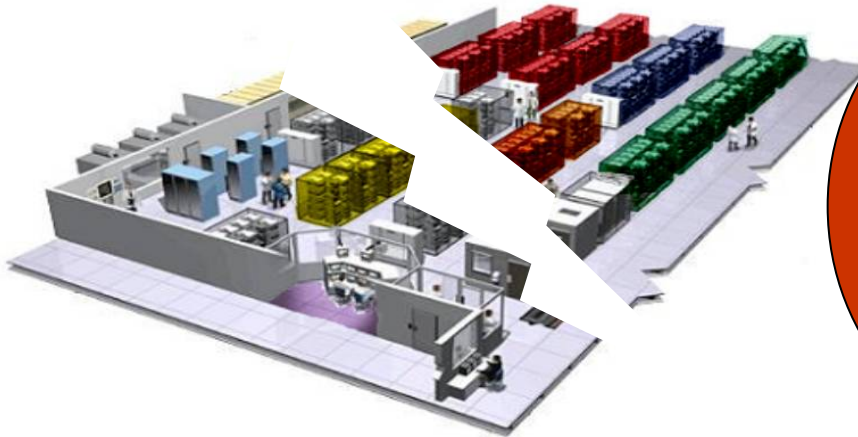
# **Maximizing Data Center Efficiencies through Microprocessor Innovations**

**Ben Williams**  
**Vice President, Commercial Business**  
**Advanced Micro Devices**

**January, 31 2006**

**Conference on Enterprise Servers and Data Centers:  
Opportunities for Energy Savings**

# Stop the \$3,000,000 Server



**Cost to Build  
50,000 ft<sup>2</sup> Data Center**

**1990's**

40watts/sq.ft  
\$400/sq.ft  
\$20,000,000

**1150%**

**2010**

500watts/sq.ft  
\$5,000/sq.ft  
\$250,000,000

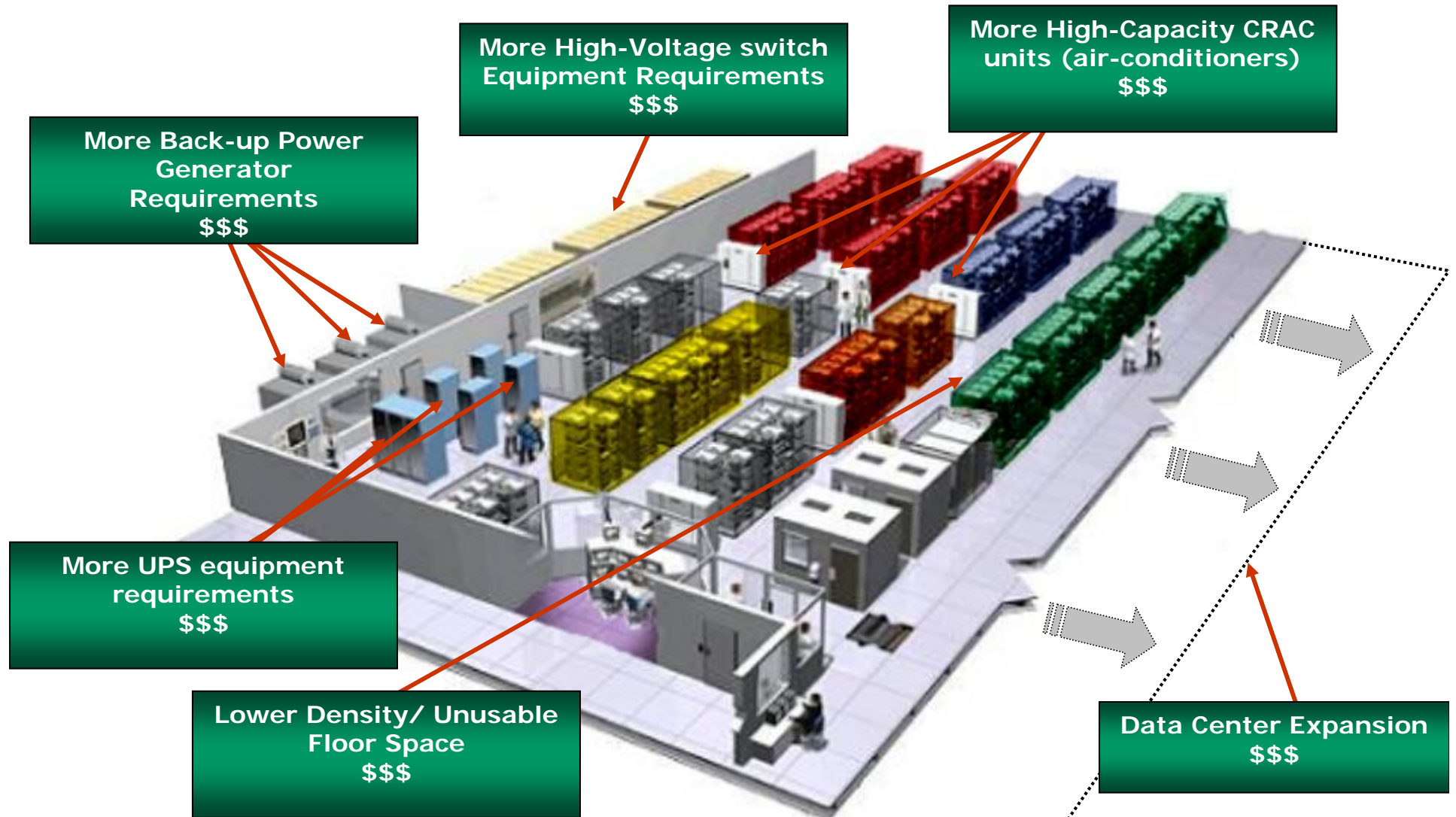
- Greatest impact can be made from "volume" x86 servers
- Innovations that contribute to a "Balanced Platform"
  - Performance-per-watt efficiencies
  - Manufacturing processes
  - Efficient microprocessor architectural

Computerworld Nov.1 2004



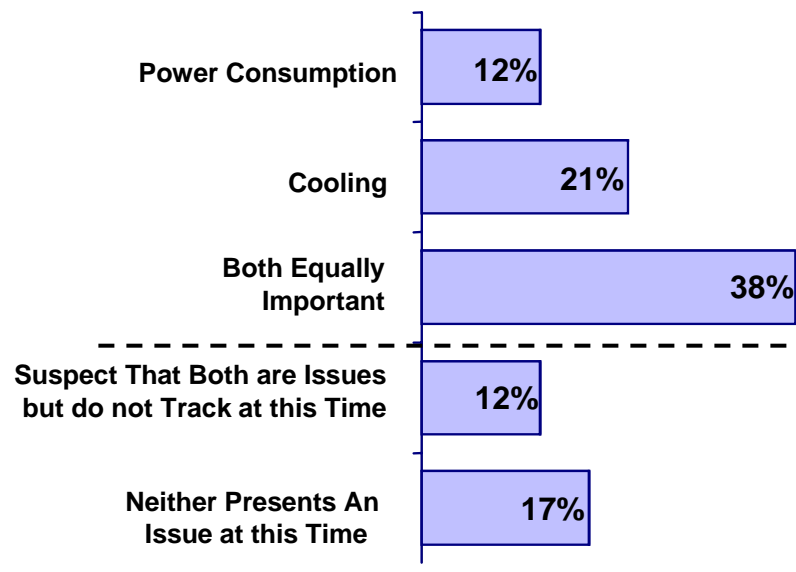
# Effects of Power in the Data Center

## It adds up quick!

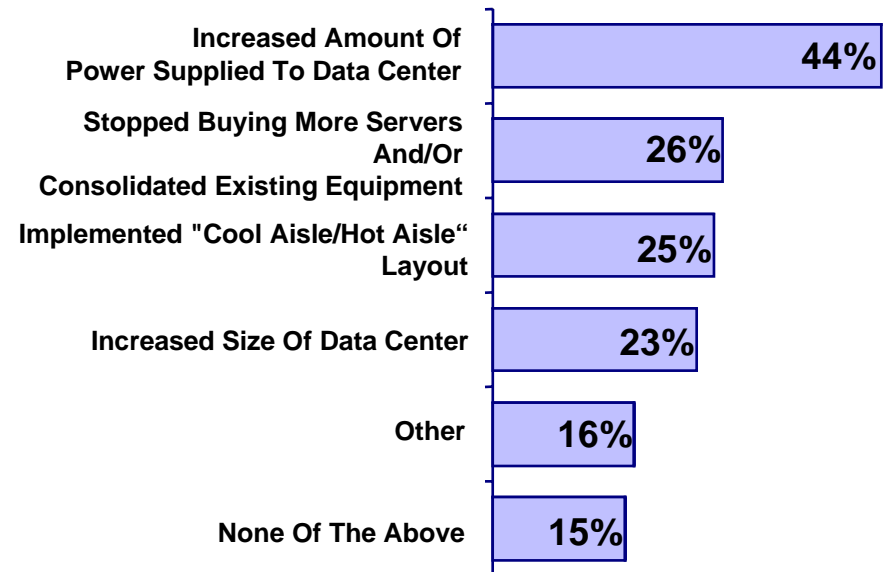


# IT Knows it has a Problem

*Power Consumption/Cooling Issues  
Tracked By Company: 71%*



*How Are Companies Addressing  
These Issues*



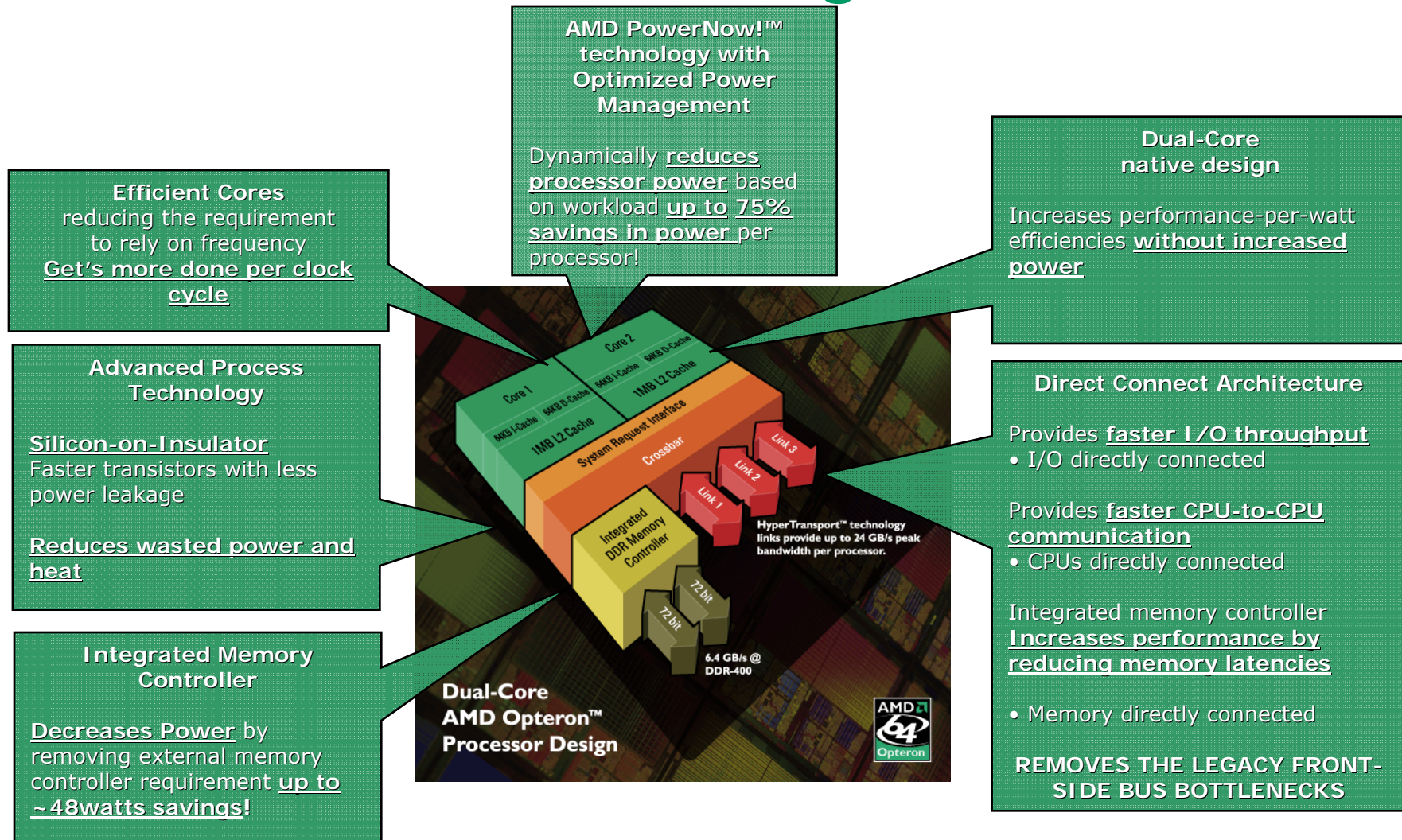
Base: 1,177 IT Decision Makers November 2005

Strategy Group/Ziff-Davis

Average of 18% of total rack space wasted due to power and cooling issues

# Performance-per-watt Efficiencies

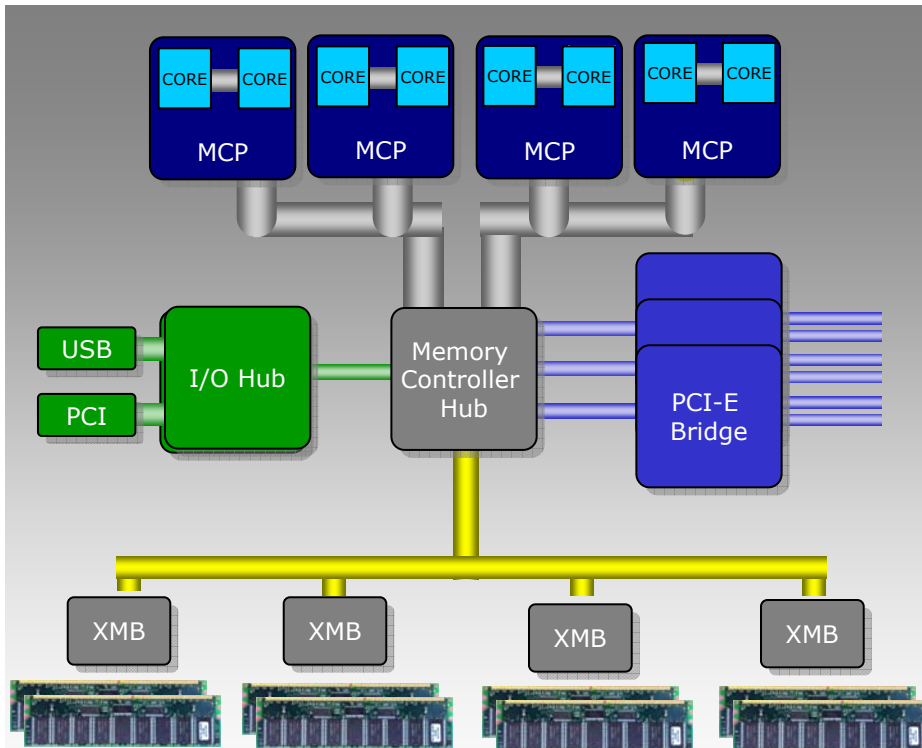
## It starts with the design





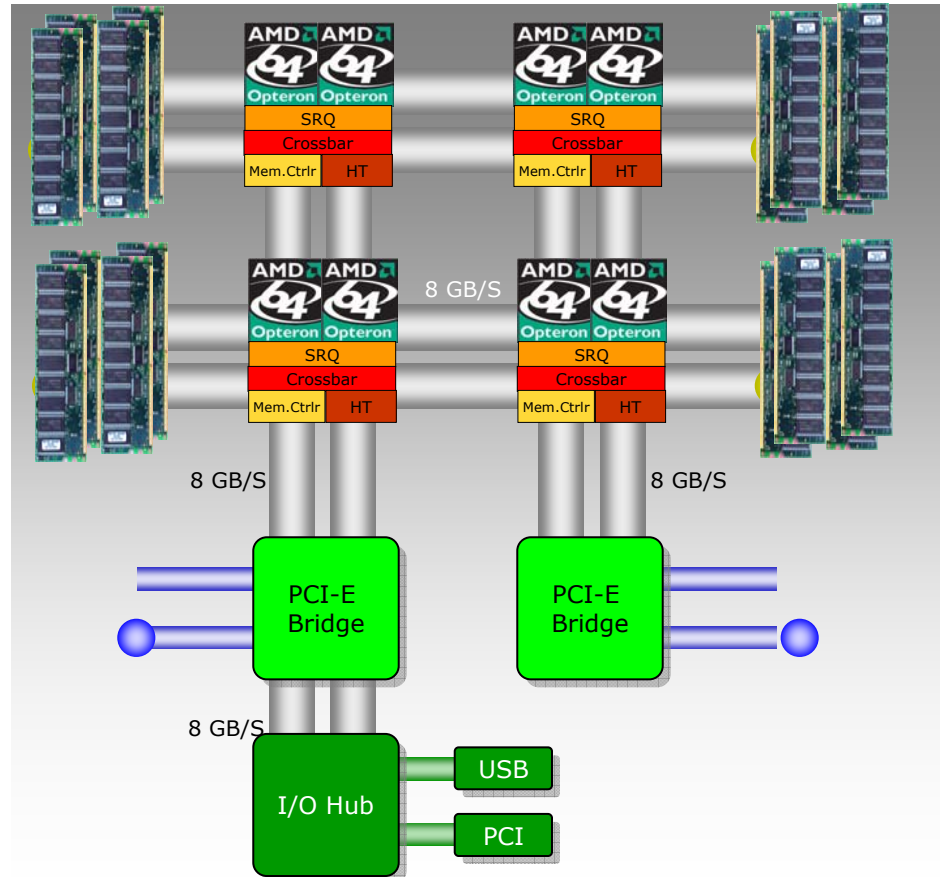
# Designing a “Balanced” Architecture

## *Effects on Performance*



### Traditional x86 Architecture

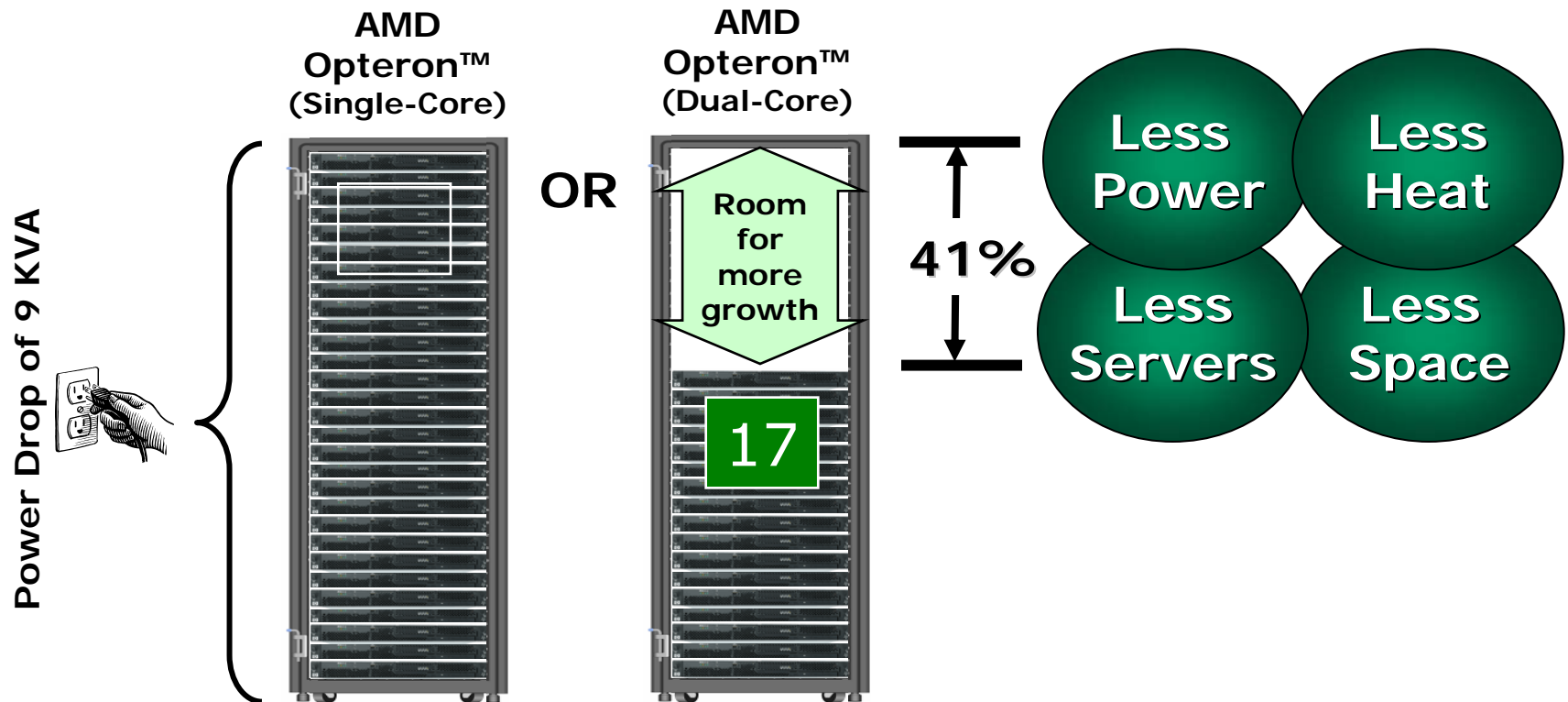
- 20-year old front-side bus architecture
- CPUs, Memory, I/O all share a bus
- Major bottleneck to performance
- Faster CPUs or more cores  $\neq$  performance



### AMD64's Direct Connect Architecture

- Industry-standard AMD64 technology
- AMD's revolutionary Direct Connect Architecture eliminates the FSB bottleneck
- HyperTransport™ technology interconnect for high bandwidth and low latency

# Dual-Core - Increasing Performance without Facilities Upgrades



## Dual-Core Processors

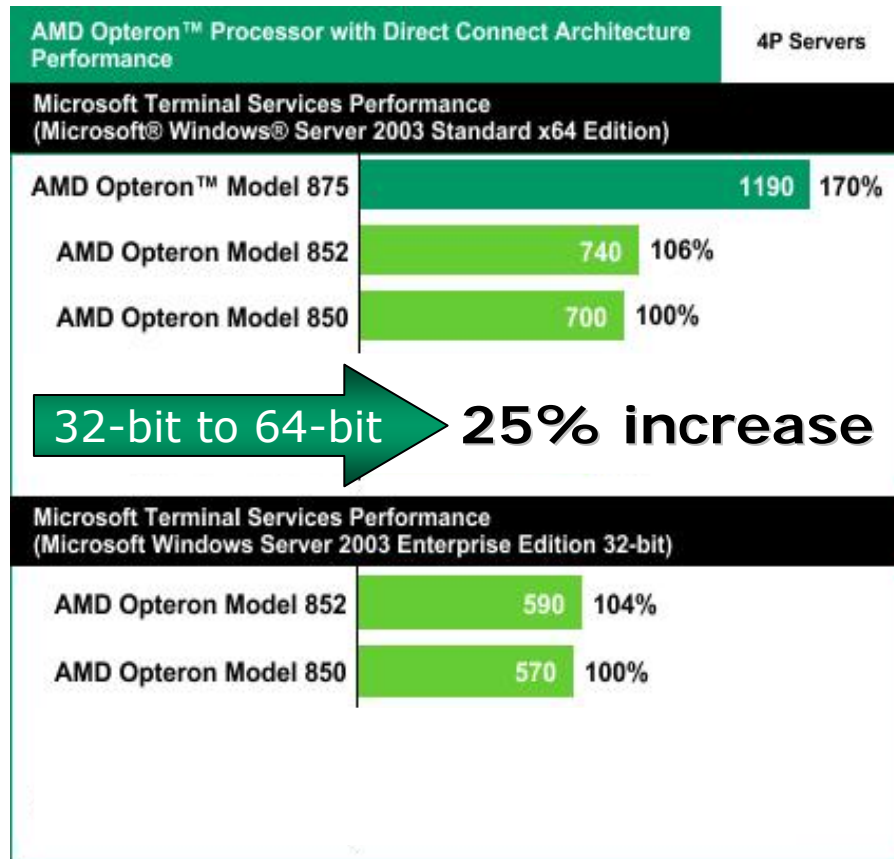
Increasing throughput within the same power and cooling envelope as single-core processors

• Performance based on SPECweb@99\_SSL  
• 82,244 connections



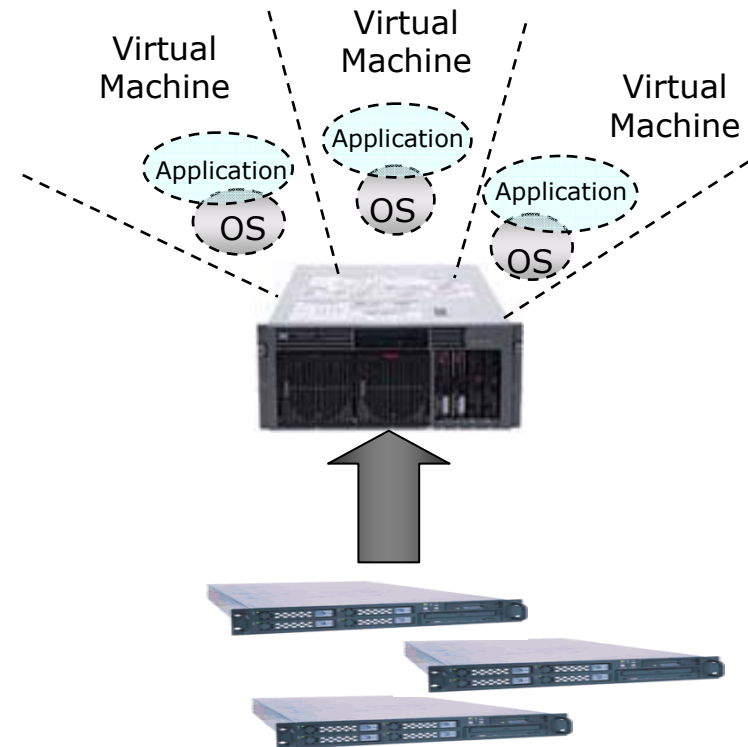
# Efficiency through Instruction Sets

## 'AMD64 Technology'



Getting more done without increased power and heat

## 'Virtualization'



Reduces number of power consuming servers



# Reducing Power and Cooling Requirements with Processor Performance States

## P-State

**P0**  
2600MHz  
1.40V  
~95watts

**P1**  
2400MHz  
1.35V  
~90watts

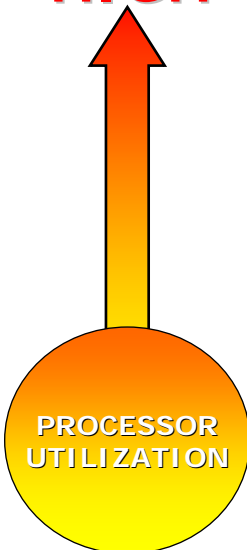
**P2**  
2200MHz  
1.30V  
~76watts

**P3**  
2000MHz  
1.25V  
~65watts

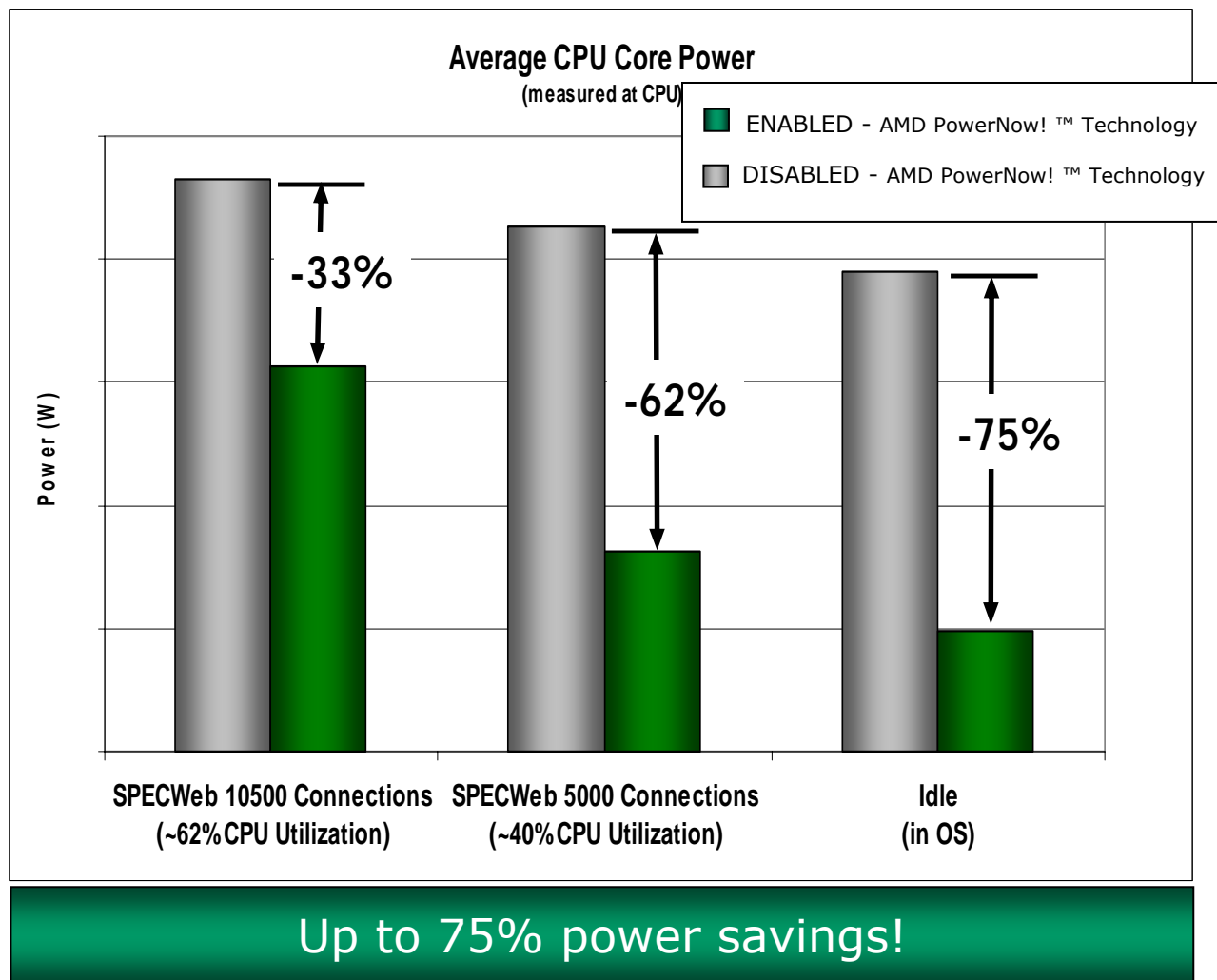
**P4**  
1800MHz  
1.20V  
~55watts

**P5**  
1000MHz  
1.10V  
~32watts

**HIGH**

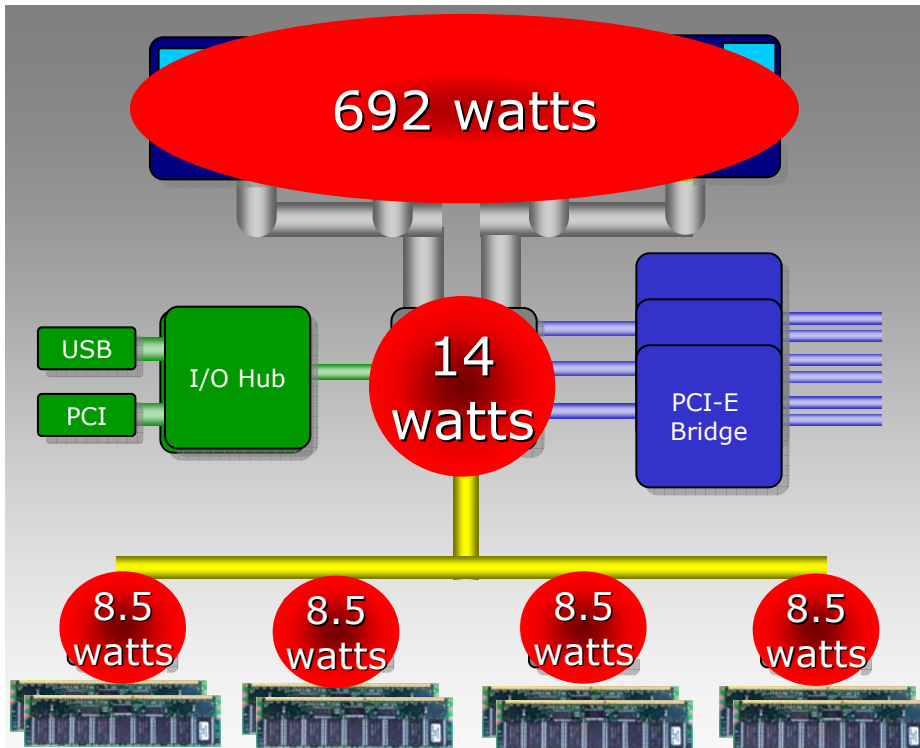


**LOW**



# Significant Impacts via a “Balanced” Architecture

## Effects on Power



### Traditional x86 Architecture

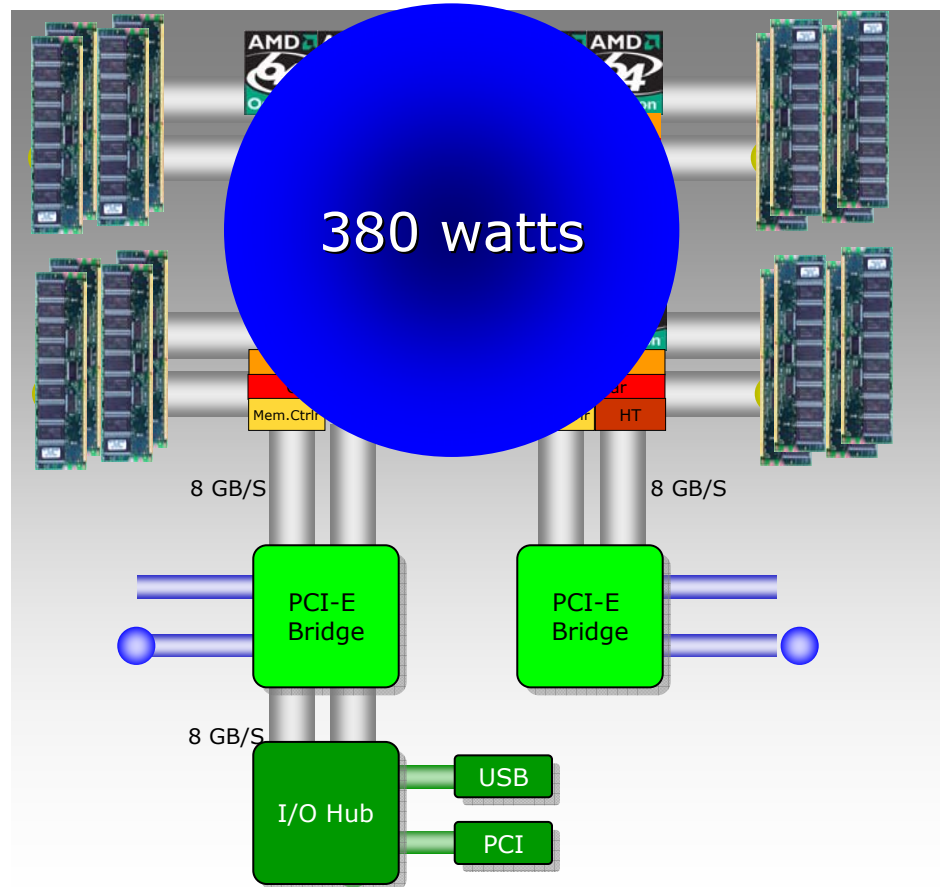
- 692 watts for processors (173w each)
- 48 watts for external memory controller

\$1037 per/year (1 server)

\$518,592 per/year (500 servers)

**95% More**

**740 watts**



### Dual-Core AMD Opteron processors

- 380 watts for processors (only 95w each)
- Integrated memory controllers

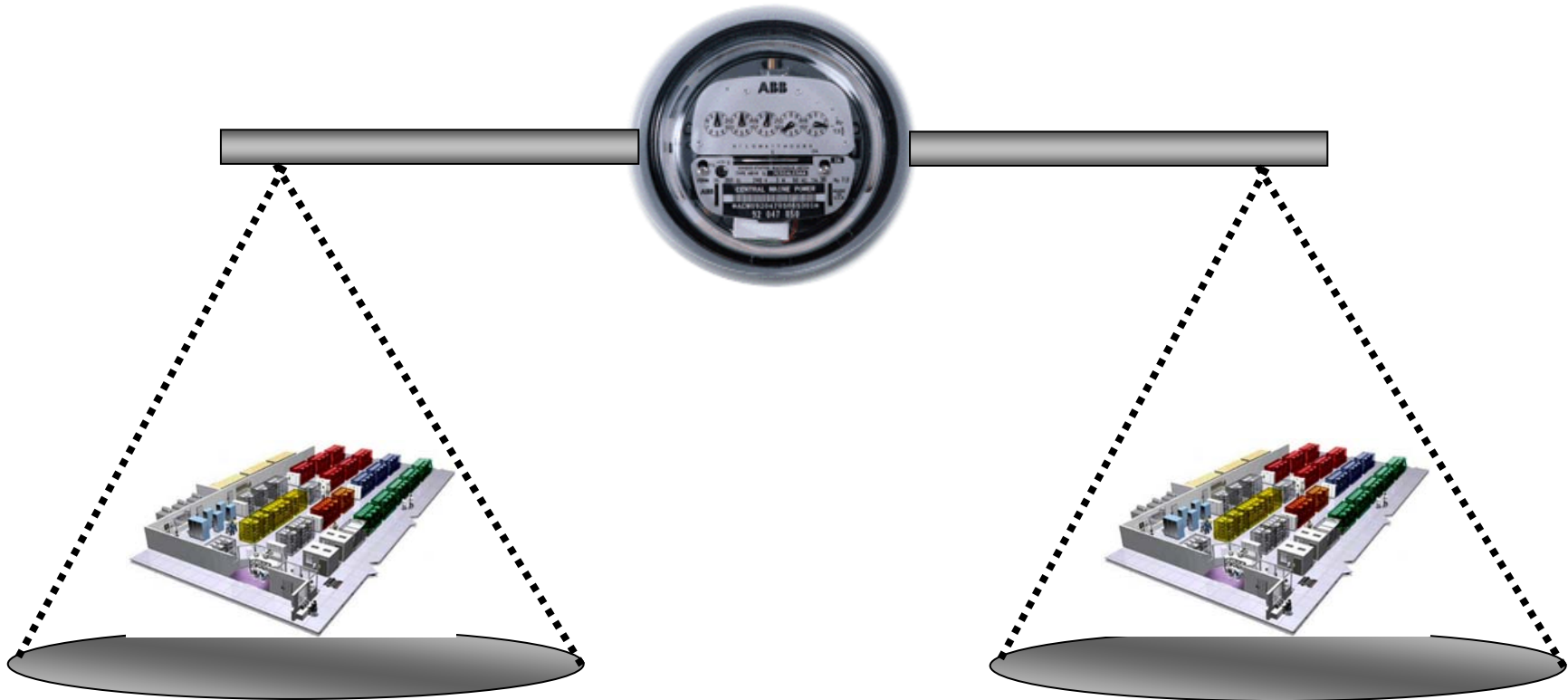
\$533 per/year (1 server)

\$266,304 per/year (500 servers)

**380 watts**

**AMD**

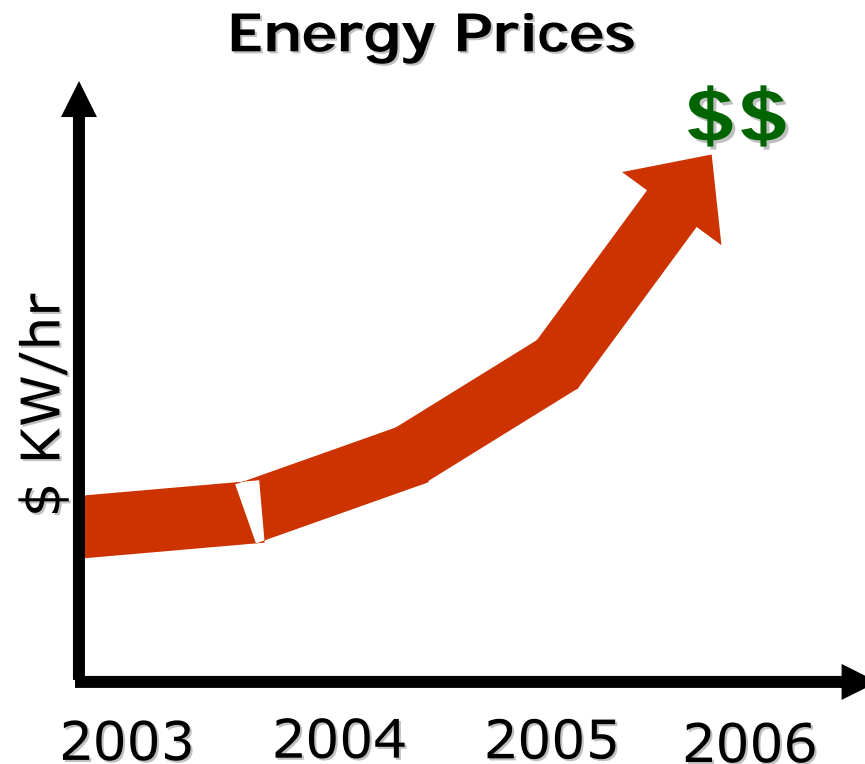
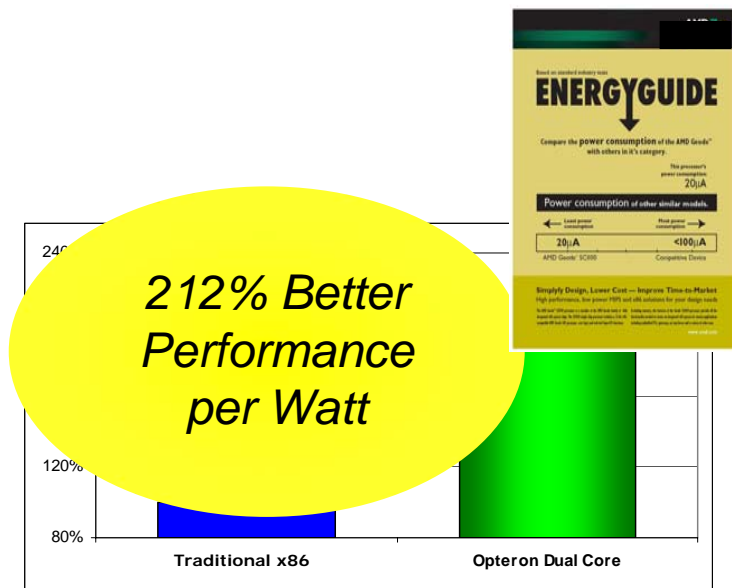
# It takes a “Balanced” Architecture



It takes a “Balanced” Microprocessor Architecture  
to maintain a “Balanced” Datacenter

# Industry Developed Metrics Enabling Energy Efficient Datacenters

- Customers are asking for energy efficient metrics



**AMD Challenges the Industry to work together to develop a energy efficiency metric**

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